

Appl. No. 10/090,103  
Response to Final Office Action Mailed September 22, 2004

PATENT

### REMARKS/ARGUMENTS

Claims 1 and 10 are amended by the instant response. Claims 1-27 remain pending.

As an initial matter, Applicants appreciate the Examiner's indication of allowable subject matter in the latest office action. Specifically, the Examiner indicated claims 23-27 were allowed, and these claims have not been amended by the instant response. It is therefore respectfully asserted that claims 23-27 remain in condition for allowance.

Turning now to the final claim rejections, embodiments in accordance with the present invention relate to methods and apparatuses wherein a silicon oxide film is formed on a substrate in a processing chamber as the result of successive introduction and purging of TEOS and ozone:

1. A method of forming a thin silicon oxide layer over a substrate disposed in a substrate processing chamber, said method comprising:  
disposing a substrate in a substrate processing chamber;  
introducing tetraethylorthosilane into the processing chamber;  
purging the tetraethylorthosilane from the processing chamber;  
introducing ozone into the processing chamber after purging of the tetraethylorthosilane to form the thin silicon oxide layer on the substrate; and  
purging the ozone from the processing chamber.

10. A method of treating a surface to receive chemical vapor deposited silicon oxide, the method comprising:  
disposing in a processing chamber, a substrate having a surface;  
exposing the surface to a silicon-containing precursor gas in the processing chamber;  
purging the silicon-containing precursor gas from the processing chamber;  
introducing an oxidant into the processing chamber after purging the silicon-containing precursor gas to form a thin silicon oxide layer; and  
purging the oxidant from the processing chamber, such that the thin layer of oxide is formed over the surface to serve as a basis for subsequent uniform chemical vapor deposition of silicon oxide.

Claims 1 and 10 have now been amended to emphasize formation of silicon oxide on a substrate disposed in a processing chamber, as indicated in the above claim listing.

Pending claim 1 stands finally rejected as anticipated under 35 U.S.C. §102 by U.S. patent no. 5,928,428 to Horie ("the Horie patent") combined with other references. These rejections are traversed as follows.

As a threshold matter, the Examiner is reminded that claim 1 stands rejected as anticipated, and not merely obvious, in light of the references relied upon by the Examiner:

[t]he distinction between rejections based on 35 U.S.C. 102 and those based on 35 U.S.C. 103 should be kept in mind. Under the former, the claim is anticipated by

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the reference. No question of obviousness is present. In other words, for anticipation under 35 U.S.C. 102, the reference must teach every aspect of the claimed invention either explicitly or impliedly. Any feature not directly taught must be inherently present. (Emphasis added; MPEP 706.02)

Here, the Horie patent, taken alone or in even in combination with other references, fails to teach depositing silicon oxide on a substrate utilizing ozone.

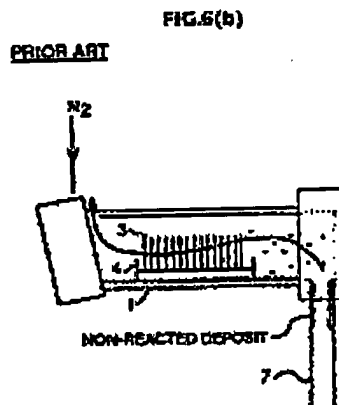
The Horie patent does describe forming silicon oxide on substrates disposed within a processing chamber. However, the Horie patent says nothing explicitly, or even implicitly, regarding the use of ozone in this deposition process.

Instead, the entire purpose of the Horie patent is reduction of substrate particle contamination by the oxidation of non-reacted TEOS residue formed in the chamber:

In the conventional apparatus and method for forming silicon oxide films on semiconductor devices as described above, the majority of TEOS gas introduced reaches the vacuum exhaust pipe 7 without being completely decomposed thermally, and deposits are formed in the pipe 7. These deposits cause out-gassing during the formation of the silicon oxide films, which in turn forms particles and deposits on the surface of the silicon wafer, lowering the reliability of the products. (Emphasis added; col. 2, lines 24-32)

\* \* \*

In the silicon oxide film forming process, nitrogen gas is introduced after film formation for a specified time, to return the chamber to normal pressure, as shown in FIG. 6(a). At this time, pressure in the chamber 1 rises to a little higher than the atmospheric pressure. Therefore, in the following boat unloading process, a back flow of the gas from the vacuum exhaust pipe 7 towards the quartz chamber 1 is caused, as shown in FIG. 6(b).



At this time, fine particles or out-gassing from the deposits which have not yet reacted reach the quartz chamber 1 and form particles. (Emphasis added; col. 2, lines 38-42)

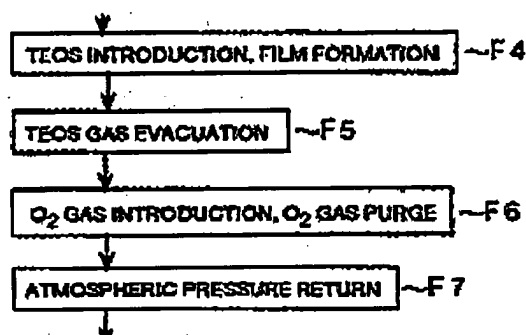
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Accordingly, the Horie patent teaches flowing an oxygen-based gas (such as ozone) to oxidize the non-reacted TEOS in the chamber:

vacuum exhaust pipe 7 is heated to a high temperature throughout the process, and the chamber 1 is evacuated while oxygen-based gas is flowing. Thereby, the oxidation of TEOS gas, which is deposited in the exhaust vacuum pipe 7 without reacting, is accelerated and their mass decreases, and their composition approaches to a silicon oxide ( $\text{SiO}_2$ ) film. Therefore, fine particles and out-gassing generated from the non-reacted gas decrease. (Emphasis added; col. 6, lines 9-16).

Consistent with this goal of reducing particle contamination, Figure 2 of the Horie patent (excerpted in part below) depicts flowing oxygen gas into the processing chamber (step F6) only after TEOS has been introduced and silicon oxide film has formed on a substrate (step F4):



There is no teaching or even suggestion in the Horie patent regarding any role played by ozone in the formation of a silicon oxide film on a substrate. As described extensively above, the role of oxygen gas in the Horie patent is to oxidize non-reacted TEOS residue present in the chamber exhaust. Significantly, neither the text nor the Figures of the Horie patent describe the presence of such non-reacted TEOS residue on the surfaces of substrates within the chamber. Indeed, such non-reacted TEOS on the substrate would serve as a source of contamination.

Because the Horie patent focuses exclusively upon the use of oxygen-based gas to oxidize un-reacted TEOS deposits in a chamber after the formation of silicon oxide films on substrates located therein, pending claim 1 cannot legitimately be anticipated by the Horie patent. The anticipation rejection of claim 1 is improper and should be withdrawn.

Pending claims 2-22 have been rejected as obvious under 35 U.S.C. §103 in view of the Horie patent combined with other references. These claim rejections are traversed as follows.

As a threshold matter, the Examiner is reminded of the following requirements to establish a prima facie case of obviousness:

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three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations. (Emphasis added; MPEP 2143)

Here, combination of the Horie patent with the U.S. patent no. 6,180,490 ("the Vassiliev patent"), or any other reference relied upon by the Examiner, fails to meet at least the first and third criteria.

Specifically, inclusion of the additional references relied upon by the Examiner fails to teach or even suggest the elements of the pending claims. For example, the Vassiliev patent does nothing to cure the lack of teaching to introduce ozone after purging TEOS, in order to form silicon oxide on a substrate. In particular, the Vassiliev patent describes deposition of silicon oxide as resulting from reaction between TEOS and ozone present in the chamber at the same time. (See generally, col. 6, lines 28-65). There is no teaching or even suggestion in the Vassiliev patent to purge TEOS before introducing ozone.

As for the Werner Gasser article relied upon by the Examiner, this reference describes an oxide formation mechanism utilizing neither TEOS nor ozone. This reference cannot be relied upon to provide a teaching regarding the TEOS and ozone-based deposition system in accordance with the claimed embodiments of the present invention.

Moreover, even if the reference combination relied upon by the Examiner did teach the claim elements, no suggestion or motivation exists to combine these references. Specifically, the Horie patent doesn't employ ozone in the formation of silicon oxide material on substrates. Rather, after the formation of silicon oxide on substrates has already occurred, the Horie patent uses ozone to oxidize un-reacted TEOS residue and thereby prevent particle contamination. Thus there can be no motivation or inspiration in the Horie patent, for its combination with either the Vassiliev patent or the Werner-Gasser article to use ozone to form such a silicon oxide layer.

By contrast, the instant application provides motivation aplenty for the use of ozone in the CVD of silicon oxide. As a final matter, however, the Examiner is cautioned that any motivation to combine reference teachings must be found in the prior art, rather than in applicant's own disclosure:

The tendency to resort to "hindsight" based upon applicant's disclosure is often difficult to avoid due to the very nature of the examination process. However, impermissible hindsight must be avoided and the legal conclusion must be

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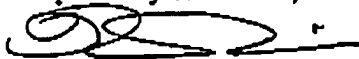
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reached on the basis of the facts gleaned from the prior art. (Emphasis added; MPEP 2142).

Owing to the complete lack of teaching in the Horie patent regarding the role of ozone in deposition of silicon oxide on substrates, continued rejection of the pending claims as obvious in light of that reference can be premised only upon the instant application, an impermissible use of hindsight. Based at least upon the above differences between the pending claims and the art relied upon by the Examiner, it is respectfully asserted that claims 1-22 cannot be considered obvious. Continued rejection of these claims is therefore improper, and the obviousness rejections should be withdrawn.

In view of the foregoing, Applicants believe all claims now pending in this Application are in condition for allowance and an action to that end is respectfully requested. If the Examiner believes a telephone conference would expedite prosecution of this application, please telephone the undersigned at 650-326-2400.

Respectfully submitted,



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